12-27-04

AF/1762

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re United States Patent Application of:		**Docket No.:**	**2771-357 DIV**
Appellant:	**Van BUSKIRK et al.**	**Examiner:**	**Eric B. FULLER**
Serial No.:	**09/928,860**	**Art Group:**	**1762**
Date Filed:	**August 13, 2001**	**Confirm. No.:**	**8391**
Title:	**SCALABLE LEAD ZIRCONIUM TITANATE (PZT) THIN FILM MATERIAL AND DEPOSITION METHOD, AND FERROELECTRIC MEMORY DEVICE STRUCTURES COMPRISING SUCH THIN FILM MATERIAL**	**Customer No.:**	**25559**

25559

EXPRESS MAIL CERTIFICATE

I hereby certify that I am mailing the attached documents to the Commissioner for Patents on the date specified, in an envelope addressed to Mail Stop Appeal Brief – Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, and Express Mailed under the provisions of 37 CFR 1.10.

Kate Turner

December 22, 2004
Date

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BRIEF ON APPEAL

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an appeal under 35 U.S.C. § 134 from the Final Rejection in the Office Action dated May 28, 2004 Office Action, of claims 38-58, 60, 62, and 65-68 of U.S. Patent Application No. 09/928,860.

12/30/2004 EABUBAK1 00000010 09928860

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REAL PARTY IN INTEREST

The real party in interest in this appeal is Advanced Technology Materials, Inc., the owner of the invention and patent rights of this application, by virtue of an Assignment of U.S. Patent Application No. 09/251,890 recorded in the assignment records of the U.S. Patent and Trademark Office on February 19, 1999 at reel 009793, frame 0595 (6 pages). The present application was filed as a continuation patent application based on U.S. Patent Application No. 09/251,890, and the Assignment document recorded against U.S. Patent Application No. 09/251,890 therefore also applies to the present application and gives the Advanced Technology Materials, Inc. rights to the subject matter of the present application.

RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to appellant, the appellant's legal representative, or assignee, which will directly effect or be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF CLAIMS

Claims 38-58, 60, 62, and 65-68 are pending in the subject application; all of these claims have been finally rejected under 35 U.S.C. §103(a) by the Examiner in the May 28, 2004 Office Action.

A copy of the appealed claims 38-58, 60, 62, and 65-68 is attached in **Appendix A** hereof.

STATUS OF AMENDMENTS

In the May 28, 2004 Office Action, claims 38-60, 62, and 64-69 were finally rejected. In the August 12, 2004 Response to Office Action, Appellants cancelled claims 59, 64, and 69, and such cancellation of claims was subsequently approved by the Examiner in the September 16, 2004 Advisory Action.[1]

SUMMARY OF THE INVENTION

The claimed invention of the present application broadly relates to methods for fabricating a ferroelectric lead zirconium titanate (PZT) film or a ferroelectric random access memory (FeRAM) device comprising

[1] The September 16, 2004 Advisory Action contains a self-evident typographic error: Claim(s) rejected should be 38-58, 60, 62, and 65-68, instead of "30-38, 60, 62, and 65-68" as listed in Section (7) of the September 16, 2004 Advisory Action.

same (see instant specification, page 2, lines 3-9).

Specifically, such ferroelectric PZT film is formed by liquid delivery metalorganic chemical vapor deposition (MOCVD) process on a substrate under **a specific set of MOCVD conditions including temperature, pressure and liquid precursor solution A/B ratio**, which are **selected according to a plateau effect determination** (see instant specification, page 9, lines 3-6).

The term "**A/B ratio**" is expressly defined by the specification of the present application as "the ratio of Pb to (Zr + Ti)" (see instant specification, page 6, lines 13-14).

The term "**plateau effect determination**" is expressly defined by the specification of the present application as "establishing ***a correlative empirical matrix*** of ***plots of each*** of ferroelectric polarization, leakage current density and atomic percent lead in PZT films, ***as a function of each*** of temperature, pressure, and liquid precursor solution A/B ratio... and identifying from the plots the 'knee' or inflection point of each plot as defining a region of operation with respect to the independent process variables of temperature, pressure and liquid precursor solution A/B ratio, and conducting the MOCVD process at a corresponding value of the temperature, pressure and liquid precursor solution A/B ratio selected from such region of operation" (see instant specification, page 6, lines 11-17).

Figure 2 of the instant specification shows an example of such a correlative empirical matrix, which is reproduced below for ease of reference:

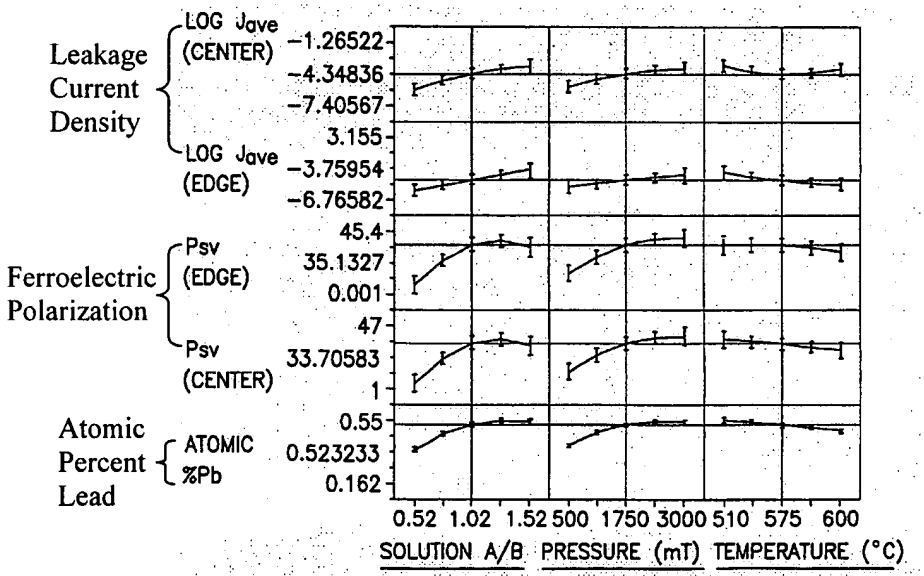


FIG.2

The features of the pending claims 38-58, 60, 62, and 65-68 are set out below in tabular format, cross-referenced to disclosure in the specification by page and line number, to facilitate the Board's review:

Claim No.	Features Recited by the Claim	Cross-Reference to the Specification
Claim 38	"A method of fabricating a ferroelectric PZT film on a substrate, comprising selecting MOCVD conditions for producing a ferroelectric PZT material, and forming the film by liquid delivery MOCVD on the substrate under said MOCVD conditions for producing said ferroelectric PZT material, wherein said selected MOCVD conditions comprises: establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti); identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure, and liquid precursor solution A/B ratio; and conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation."	Page 9, lines 3-8. Page 6, lines 11-18.
Claim 39	"wherein the MOCVD conditions include use of a lead source reagent selected from the group consisting of $Pb(thd)_2$ and $Pb(thd)_2$pmdeta."	Page 14, lines 14-15 and 18-19.
Claim 40	"wherein the MOCVD conditions include use of a zirconium source reagent selected from the group consisting of $Zr(thd)_4$ and $Zr(O\text{-}i\text{-}Pr)_2(thd)_2$."	Page 14, lines 17 and 19-20.
Claim 41	"wherein the MOCVD conditions include use of $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ as a titanium source reagent."	Page 14, lines 15-16.
Claim 42	"wherein the MOCVD conditions include use of $Pb(thd)_2$, $Ti(O\text{-}i\text{-}Pr)_2$ and $Zr(thd)_4$ as respective lead, titanium and zirconium source reagents."	Page 14, lines 14-17.
Claim 43	"wherein the MOCVD conditions include use of $Pb(thd)_2$pmdeta, $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ and $Zr(thd)_4$ as respective lead, titanium and zirconium source reagents."	Page 14, lines 14-20.

Claim No.	Features Recited by the Claim	Cross-Reference to the Specification
Claim 44	"wherein the MOCVD conditions include use of $Pb(thd)_2$pmdeta, $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ and $Zr(O\text{-}i\text{-}Pr)_2(thd)_2$ as respective lead, titanium and zirconium source reagents."	Page 14, lines 14-20.
Claim 45	"wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising one or more solvent species selected from the group consisting of: tetrahydrofuran, glyme solvents, alcohols, hydrocarbon solvents, hydroaryl solvents, amines, polyamines, and mixtures of two or more of the foregoing."	Page 19, lines 20-21.
Claim 46	"wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising tetrahydrofuran: isopropanol: tetraglyme in an 8:2:1 volume ratio."	Page 15, lines 11-12; page 19, lines 21-22.
Claim 47	"wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising octane: decane: polyamine in a 5:4:1 volume ratio."	Page 15, line 15; page 19, line 23.
Claim 48	"wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising octane: polyamine in a 9:1 volume ratio."	Page 15, lines 15-16.
Claim 49	"wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising tetrahydrofuran."	Page 15, lines 16-17.
Claim 50	"wherein the substrate comprises a noble metal."	Page 24, lines 15-17.
Claim 51	"wherein the substrate comprises a noble metal selected from the group consisting of iridium, platinum, and combination thereof."	Page 24, lines 15-17.
Claim 52	"wherein the substrate comprises a TiAlN barrier layer overlaid by an iridium layer."	Page 24, lines 14-17.
Claim 53	"wherein the liquid delivery MOCVD includes vaporization of a source reagent solution to form precursor vapor therefrom and flow the precursor vapor to a CVD chamber in a carrier gas."	Page 16, lines 11-13.
Claim 54	"wherein the carrier gas is selected from the group consisting of argon, helium and mixture thereof."	Page 16, line 13; page 19, line 28.

Claim No.	Features Recited by the Claim	Cross-Reference to the Specification
Claim 55	"further comprising flowing to the CVD chamber an oxidant medium including at least one species selected from the group consisting of O_2, O_3, N_2O, and O_2/N_2O."	Page 15, lines 14-15; page 19, lines 28-29.
Claim 56	"A method of fabricating a ferroelectric PZT film on a substrate, comprising selecting MOCVD conditions including nucleation conditions producing a ferroelectric PZT material, and forming the film by liquid delivery MOCVD on the substrate under said MOCVD conditions, wherein said selected MOCVD conditions comprises: establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti); identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure, and liquid precursor solution A/B ratio; and conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation."	Page 9, lines 3-8; page 10, lines 14-21. Page 6, lines 11-18.
Claim 57	"A method for fabricating a ferroelectric PZT film on a substrate, comprising forming the film by liquid delivery MOCVD on the substrate under MOCVD conditions including temperature, pressure and liquid precursor solution A/B ratio determined by plateau effect determination from a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti)."	Page 9, lines 3-8; page 6, lines 11-18.
Claim 58.	"A method of fabricating a ferroelectric PZT film on a substrate, comprising forming the film by liquid delivery MOCVD on the substrate under MOCVD conditions including temperature, pressure and liquid precursor solution A/B ratio determined by plateau effect determination from a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density and atomic percent lead in PZT	Page 9, lines 3-8; page 6, lines 11-18.

Claim No.	Features Recited by the Claim	Cross-Reference to the Specification
	films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti), and wherein said ferroelectric PZT film comprises a ferroelectric PZT material having at least one scalable character selected from the group consisting of dimensionally scalable character, pulse length scalable character and E-field scalable character, and wherein said PZT material has at least one property selected from the group consisting of having a thickness of from about 20 to about 150 nanometers, having a ferroelectric operating voltage below 2 Volts, having at least one Type 1 properties and having at least one Type 2 properties."	Page 10, lines 22-26; page 23, lines 12-14 Page 6, lines 1-6; page 20, lines 13-16
Claim 60	"A method of fabricating a FeRAM device, comprising selecting MOCVD conditions producing a ferroelectric PZT material, and forming a capacitor on a substrate including a ferroelectric PZT material, wherein the ferroelectric PZT material is deposited by liquid delivery MOCVD under said MOCVD conditions yielding said ferroelectric PZT material, wherein said selected MOCVD conditions comprises: establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti); identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure, and liquid precursor solution A/B ratio; and conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation."	Page 8, lines 11-13; page 15-17; page 9, lines 3-8. Page 6, lines 11-18.
Claim 62	"wherein the PZT film defines a capacitor area of from about 10^4 μm^2 to about 10^{-2} μm^2."	Page 8, lines 11-13.
Claim 65	"wherein said MOCVD conditions comprise temperature in a range from about 400°C to about 1200°C, pressure in a range from about 0.1 to about 760 torr, and liquid precursor solution A/B ratio in a range of from about 0.52 to about 1.52."	Page 16, lines 15-17; Figure 2.
Claim 66	"wherein said ferroelectric PZT film has a	Page 13, lines 4-5.

Claim No.	Features Recited by the Claim	Cross-Reference to the Specification
	ferroelectric polarization of greater than 20 $\mu C/cm^2$."	
Claim 67	"wherein said ferroelectric PZT film has a leakage current density of less than 10^{-4} A/cm^2."	Page 13, line 15.
Claim 68	"wherein said ferroelectric PZT film has an atomic percent lead in a range of from about 49.43% to about 55%."	Page 44, Table 3, line 2.

REFERENCES

The following references were cited under 35 U.S.C. §103(a) in the May 28, 2004 Office Action finally rejecting the pending claims 38-58, 60, 62, and 65-68:

(a) **Satoh** et al. U.S. Patent No. 5,757,061 (hereinafter "Satoh");
(b) **Roeder** et al. Liquid Delivery MOCVD of Ferroelectric PZT, MAT. RES. SYMP. PROC., Vol. 415, pp. 123-128 (1996) (hereinafter "Roeder");
(c) **Miller** U.S. Patent No. 3,805,195 (hereinafter "Miller");
(d) **Kim** et al. U.S. Patent No. 6,229,166 (hereinafter "Kim");
(e) **Miki** et al. U.S. Patent No. 6,309,894 (hereinafter "Miki");
(f) **Baum** et al. U.S. Patent No. 5,916,359 (hereinafter "Baum"); and
(g) **Visokay** et al. U.S. Patent No. 6,211,034 (hereinafter "Visokay").

ISSUES

The issues presented in this appeal are:

(1) Whether claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68 are unpatentable under 35 U.S.C. §103(a) as being obvious over **Satoh** in view of **Roeder** and **Miller**.
(2) Whether claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68 are unpatentable under 35 U.S.C. §103(a) as being obvious over **Miki** in view of **Roeder** and **Miller**.
(3) Whether claims 43-49 are unpatentable under 35 U.S.C. §103(a) as being obvious over **Miki** in view of **Roeder** and **Miller**, further in view of **Baum**.
(4) Whether claim 56 is unpatentable under 35 U.S.C. §103(a) as being obvious over **Satoh** in view of **Roeder** and **Miller**, further in view of **Kim**.

(5) Whether claim 56 is unpatentable under 35 U.S.C. §103(a) as being obvious over **Miki** in view of **Roeder** and **Miller**, further in view of **Kim**.

GROUPING OF THE CLAIMS

Group I: Claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68 constitute a unitary group of claims presenting common issues in respect of their patentability. Claim 38 is representative of the group.

Group II: Claims 43-49 constitute a unitary group of claims presenting common patentability issues that are independent of those of claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68. Claim 43 is representative of the group.

Group III: Claim 56 presents patentability issues that are independent of those of claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68. Claim 56 is representative of the group.

Appellant hereby states that the pending claims 38-58, 60, 62, and 65-68, to the extent separately identified hereinabove in Groups I-III and argued at below, do not stand or fall together.

ARGUMENT

In the ensuing discussion, the basis of patentability of the representative claim over the cited reference(s) will be set forth for each of the grounds of rejection (1)-(5) identified in the preceding two sections ("ISSUES" and "GROUPING OF CLAIMS", respectively).

Issue 1-Patentability of Claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68, rejected under 35 U.S.C. §103(a) as being obvious over Satoh in view of Roeder and Miller – Claim 38 is representative

This rejection is traversed because the Examiner failed to establish a *prima facie* case of obviousness to support such rejection.

The Office has the initial burden of showing a *prima facie* case of obviousness. *In re Bell*, 26 U.S.P.Q.2d 1529, 1530 (Fed. Cir. 1993). In order to properly establish a *prima facie* case of obviousness based on combined teaching of several references, the Examiner must show that the difference between the combination of the prior art references and the claims at issue is obvious to a person ordinarily skilled in the art. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966).

Appellants respectfully submit that the Examiner has failed to satisfy the burden of proving a *prima facie* case of obviousness, by failing to show that the difference between the combination of teachings by Satoh, Roeder and Miller and the claims at issue are obvious to a person ordinary skilled in the art.

Independent claim 38, which is representative of claims 39-42, 50, 51-55, 57-58, 60, 62, and 65-68, expressly recites selecting MOCVD conditions by:

> "**establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio**, wherein A/B ratio is the ratio of Pb to (Zr + Ti);
>
> identifying from said plots an inflection point of **each** plot as defining a region of operation with respect to independent process variables of temperature, pressure and liquid precursor solution A/B ratio; and
>
> conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation."

The language of claim 38 clearly and unequivocally states that **the correlative empirical matrix** contain plots of "**each of**" (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead, as a function of "**each of**" (a) temperature, (b) pressure, and (c) liquid precursor solution A/B ratio.

In other words, such correlative empirical matrix as required by claim 38 must **concurrently** contain:

(1) at least one plot of ferroelectric polarization as a function of temperature;
(2) at least one plot of ferroelectric polarization as a function of pressure;
(3) at least one plot of ferroelectric polarization as a function of liquid precursor solution A/B ratio;
(4) at least one plot of leakage current density as a function of temperature;
(5) at least one plot of leakage current density as a function of pressure;
(6) at least one plot of leakage current density as a function of liquid precursor solution A/B ratio;
(7) at least one plot of atomic percent lead as a function of temperature;
(8) at least one plot of atomic percent lead as a function of pressure; **and**

(9) at least one plot of atomic percent lead as a function of liquid precursor solution A/B ratio.

An example of such a correlative empirical matrix is shown in Figure 2 of the instant specification, as shown again below:

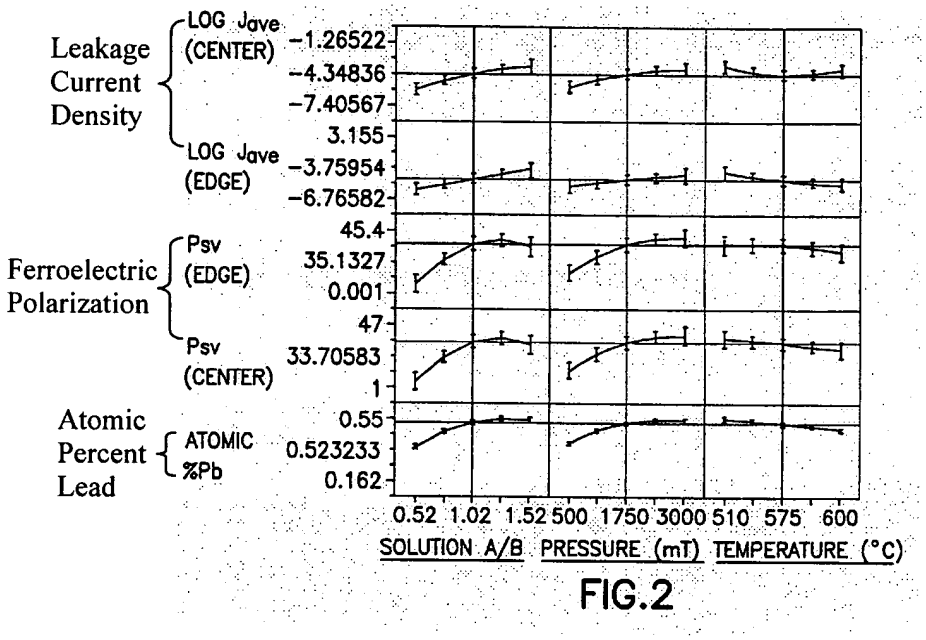


FIG.2

None of the cited references Satoh, Roeder, and Miller teaches or suggests establishment of such a correlative empirical matrix as required by claim 38.

In the May 28, 2004 Office Action, the Examiner asserted that the Roeder reference "teaches plateau effect distribution" at page 3 last paragraph to page 6 "in order to determine the user variables that optimize the properties and deposition of the PZT material," and that "it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use plateau effect distribution to determine the user variables in the process taught by Satoh" for optimizing the properties and deposition of the PZT material (see the Office Action, page 3, lines 6-11).

However, the Roeder reference only discloses the correlations between the precursor A/B ratio and the film composition and properties, such as dielectric constant, remanent polarization, and film orientation, at two discrete deposition temperatures 550°C and 590°C (see Roeder, pages 3-6, Section for "Properties as a function of A/B/ ratio in the precursors"; Figures 2, 6 and 7).

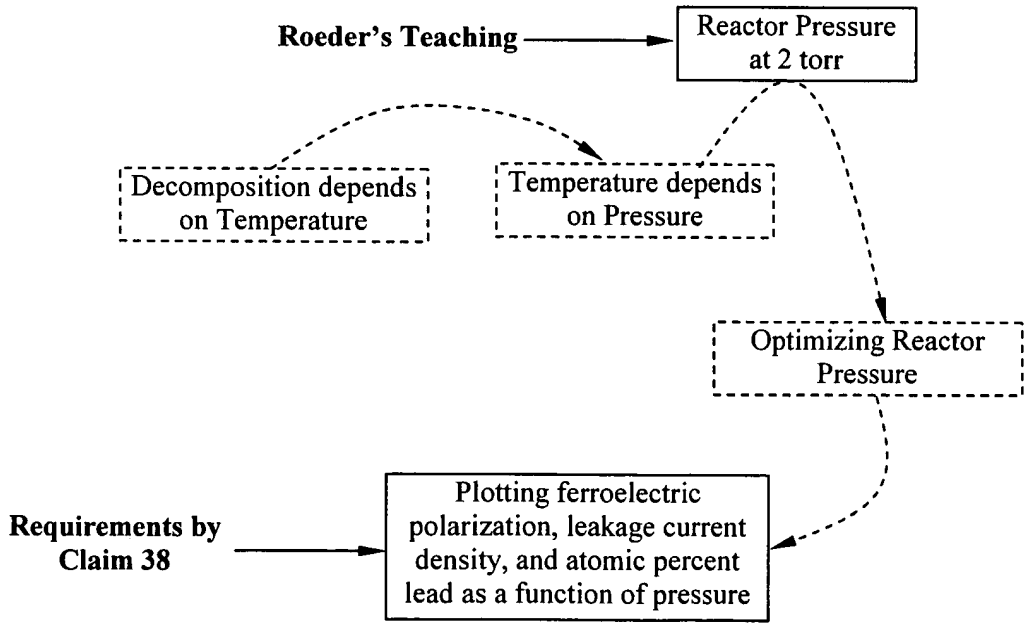
Nothing in Roeder teaches or suggests establishment of a correlative empirical matrix containing plots of each of (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead as a function of **pressure**, as expressly required by claim 38.

The only disclosure Roeder contains regarding the deposition **pressure** is on page 2, line 2, which states that "**[total] reactor pressure was maintained at 2 torr**."

Roeder does not teach or suggest, or even contemplate, modification of such reactor pressure or use of a different reactor pressure, much less the plotting the ferroelectric polarization, leakage current density, and atomic percent lead as a function of pressure, as required by claim 38.

In the September 16, 2004 Advisory Action, the Examiner argued that since the reaction is a decomposition of a metal organic, one of ordinary skill in the art would recognize that the decomposition reaction is dependent on both temperature and pressure, because the temperature is dependent on the pressure, and that it would have been obvious to optimize the pressure of the reaction chamber of the optimization means taught by Roeder (see Advisory Action, page 2, lines 13-18).

The Examiner's attempt in filling the gaps between the teaching by Roeder and the claimed invention as defined by claim 38 can be best illustrated by the following diagram:



As shown by this diagram, such attempt by the Examiner depends on not just one, but several, "leaps of imagination" from Roeder's teaching of a reactor pressure of 2 torr, as a beginning point, to the requirements of claim 38 involving construction and use of plots of ferroelectric polarization, leakage current density, and atomic percent lead as a function of pressure.

It is well established that when determining patentability of an invention, the Patent Office cannot simply reach conclusions based on its own understanding or experience – or on its assessment of what would be basic knowledge or common sense. Rather, the Patent Office must point to some concrete evidence in the record to support its determination. *In re Zurko*, 59 U.S.P.Q. 1693 (Fed. Cir. 2001).

In this case, the Examiner did NOT provide any concrete evidence in support of the attempted leaps of imagination from Roeder's teaching to the requirements of Appellants' claim 38.

Therefore, the Examiner's arguments cannot support a *prima facie* case of obviousness against Appellants' claimed invention as defined by claim 38.

In the September 16, 2004 Advisory Action, the Examiner further argued that since "selection of reaction parameters such as temperature and pressure has been held by the courts to have been obvious," and since "[it] is also well settled that determination of optimum values of cause effective variables such as these process parameters is within the skill of one practicing in the art," it therefore is obvious to "optimize cause effective variables by the method taught in Roeder" (see Advisory Action, page 2, lines 19-20 and page 3, lines 1-6).

However, claim 38 of the present invention does NOT merely require selection of pressure, but rather it requires a very specific methodology for selecting the pressure, which involves the specific steps of plotting ferroelectric polarization, leakage current density, and atomic percent lead as a function of pressure.

Selection and optimization of pressure can be conducted by many different methodologies and techniques.

There is no evidence or rational basis for the position that a person seeking to select and optimize reactor pressure would in any way logically extrapolate such effort to yield the specific methodology of claim 38.

In other words, the Examiner's allegation of obviousness against selection of pressure parameter in general does not support a *prima facie* case of obviousness against the specific methodology of selection required by claim 38, which involves specific plotting of ferroelectric polarization, leakage current density, and atomic percent lead as a function of pressure.

Thus, Roeder does not provide any derivative basis for establishment of a correlative empirical matrix containing plots of each of (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead as a function of pressure, as expressly required by claim 38.

Further, nothing in Roeder teaches or suggests establishment of a correlative empirical matrix containing plots of each of (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead as a function of **temperature**, as expressly required by claim 38.

Instead, Roeder expressly states at page 2, last paragraph and page 3, lines 1-2 that:

> "Values [of dielectric constant] are shown in Figure 2 for films deposited at 550 and 590°C. The fact that the values fall along the same line indicates that **the films are qualitatively similar for both deposition temperatures**."
> (emphasis added)

Such statement by Roeder in fact **teaches away** from adjustment of deposition temperature for optimizing PZT film properties.

A person ordinarily skilled in the art, after reading such statement by Roeder, would not in any way be motivated to plot ferroelectric polarization, leakage current density, and atomic percentage lead as a function of temperature, as required by claim 38 of the present application.

In the September 16, 2004 Advisory Action, the Examiner has asserted that "Roeder explicitly teaches that plateau effect distribution graphs are affected by temperature," pointing to pages 2 and 3 of Roeder and the disclosure therein about two different temperatures, 550°C and 590°C (see Advisory Action, page 2, lines 9-11).

Such assertion by the Examiner is inconsistent with the above-quoted statement by Roeder on pages 2 and 3 and is therefore incorrect.

Thus, Roeder does not provide any derivative basis for establishment of a correlative empirical matrix containing plots of each of (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead as a function of pressure, as expressly required by claim 38.

Nothing in the Satoh or Miller reference remedies the above-explained deficiencies of Roeder.

It therefore is respectfully requested that the Board take cognizance of the absence of any proper basis of the §103 rejection of claim 38, as representative of Group I claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68, and correspondingly reverse the Examiner's rejection of such claims.

Issue 2-Patentability of Claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68, rejected under 35 U.S.C. §103(a) as being obvious over Miki in view of Roeder and Miller – Claim 38 is representative

As stated hereinabove, Appellants' claimed invention as recited by the representative claim 38 requires establishment of a **correlative empirical matrix** containing plots of **each of** (i) ferroelectric polarization, (ii) leakage current density, and (iii) atomic percent lead, as a function of **each of** (a) temperature, (b) pressure, and (c) liquid precursor solution A/B ratio.

As discussed hereinabove, neither of Roeder and Miller provides any derivative basis for the establishment of such correlative empirical matrix.

Miki only discloses formation of ferroelectric PZT films, but it does not disclose the use of liquid delivery MOCVD for depositing PZT films, and much less the selection of specific MOCVD conditions.

Miki does not remedy the deficiency of Roeder and Miller, and the hypothetical combination of Miki, Roeder and Miller does not support a *prima facie* case of obviousness.

It therefore is respectfully requested that the Board take cognizance of the absence of any proper basis of the §103 rejection of claim 38, as representative of Group I claims 38-42, 50, 51-55, 57-58, 60, 62, and 65-68, and correspondingly reverse the Examiner's rejection of such claims.

Issue 3-Patentability of Claims 43-49, rejected under 35 U.S.C. §103(a) as being obvious over Miki in view of Roeder and Miller, further in view of Baum – Claim 43 is representative

Group II claims 43-49, dependent from claim 38, are patentably distinguished over Miki, Roeder, and Miller, by virtue of their dependency from claim 38 and for the corresponding reasons advanced in the preceding discussion of the patentability of the Group I claims.

Further, such claims 43-49, of which claim 43 is representative, are patentable on their own merit, for further requiring specific source reagents and solvent media.

In the May 28, 2004 Office Action, the Examiner expressly conceded that Miki, Roeder, and Miller fail to teach or suggest the specific source reagents and solvent media as required by claim 43, but attempted to remedy such deficiency of Miki, Roeder, and Miller references by citing the Baum reference (see Office Action, page 7, lines 8-11).

The Baum reference is a U.S. patent that was issued on June 29, 1999 to Advanced Technology Materials, Inc.

The present application is a continuation of U.S. Patent Application No. 09/251,890 filed on February 19, 1999, which is prior to the issue date of the Baum reference. The present application as well as U.S. Patent Application No. 09/251,890 was assigned to Advanced Technology Materials, Inc. at the time the present invention was made.

Therefore, the Baum reference qualifies as prior art only under 35 U.S.C. §102(e).

Since the Baum patent and the claimed invention of the present application were owned by the same person, i.e., Advanced Technology Materials, Inc., at the time the present invention was made, **the Baum reference is removed from the prior art under the provisions of 35 U.S.C. §103(c)**.

As a result of the removal of the Baum reference, the Examiner's hypothetical combination of the remaining Miki, Roeder and Miller references does not teach each and every element of the claimed invention as required by claim 43, and therefore cannot support a *prima facie* case of obviousness.

It therefore is respectfully requested that the Board take cognizance of the absence of any proper basis of the §103 rejection of claim 43, as representative of Group II claims 43-49, and correspondingly reverse the Examiner's rejection of such claims.

Issue 4-Patentability of Claim 56, rejected under 35 U.S.C. §103(a) as being obvious over Satoh in view of Roeder and Miller, further in view of Kim – Claim 56 is representative

Group III claim 56 is patentably distinguished over Satoh, Roeder, and Miller, by virtue of its recitation of corresponding limitations as are recited in claim 38 and for the corresponding reasons advanced in the preceding discussion of the patentability of the Group I claims.

Further, such claim 56 is patentable on its own merit, for further requiring selection of MOCVD conditions including nucleation conditions using the claimed correlative empirical matrix.

In the May 28, 2004 Office Action, the Examiner stated that Satoh, Roeder, and Miller fail to teach or suggest "the nucleation layer," but the Examiner attempted to remedy such deficiency by citing the Kim reference (see Office Action, page 5, lines 8-12).

However, the language of claim 56 clearly requires **selection of nucleation conditions by using the claimed correlative empirical matrix, instead of a nucleation layer**.

Nothing in Kim teaches or suggests selection of nucleation conditions, much less selection of nucleation conditions using the specific correlative empirical matrix required by claim 56.

It therefore is respectfully requested that the Board take cognizance of the absence of any proper basis of the §103 rejection of claim 56, and correspondingly reverse the Examiner's rejection of such claim.

Issue 5-Patentability of Claim 56, rejected under 35 U.S.C. §103(a) as being obvious over Miki in view of Roeder and Miller, further in view of Kim – Claim 56 is representative

Group III claim 56 is patentably distinguished over Miki, Roeder, and Miller, by virtue of its recitation of corresponding limitations as are recited in claim 38 and for the corresponding reasons advanced in the preceding discussion of the patentability of the Group I claims.

Further, such claim 56 is patentable on its own merit, for further requiring selection of MOCVD conditions including nucleation conditions using the claimed correlative empirical matrix.

In the May 28, 2004 Office Action, the Examiner stated that Miki, Roeder, and Miller fail to teach or suggest "the nucleation layer," but attempted to remedy such deficiency by citing the Kim reference (see Office Action, page 8, lines 13-19).

As mentioned hereinabove, claim 56 requires **selection of nucleation conditions by using the claimed correlative empirical matrix**, not **a nucleation layer**.

Nothing in Kim teaches or suggests selection of nucleation conditions, much less selection of nucleation conditions using the specific correlative empirical matrix required by claim 56.

It therefore is respectfully requested that the Board take cognizance of the absence of proper basis of the §103 rejection of claim 56, and correspondingly reverse the Examiner's rejection of such claim.

CONCLUSION

Based on the foregoing arguments and cited legal precedent, it is respectfully requested that the Board of Patent Appeals and Interferences reverse the decision of the Examiner finally rejecting claims 38-58, 60, 62, and 65-68 now pending in the application, consistent with the patentability of such claims over the cited art references.

This brief is provided in triplicate. No oral hearing is requested.

Enclosed with this appeal brief is a Credit Card Payment form, authorizing the Office to charge the office fee in the amount of $500.00 under 37 C.F.R. §1.17(c) to the credit card specified therein. Please charge any deficiency and credit any excess payment to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

Respectfully submitted,

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APPENDIX A

Appeal Claims 38-58, 60, 62, and 65-68 in a Listing of Claims 1-69

1-37. (Canceled)

38. (Previously presented) A method of fabricating a ferroelectric PZT film on a substrate, comprising selecting MOCVD conditions for producing a ferroelectric PZT material, and forming the film by liquid delivery MOCVD on the substrate under said MOCVD conditions for producing said ferroelectric PZT material, wherein said selecting MOCVD conditions comprises:

establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti);

identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure and liquid precursor solution A/B ratio; and

conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation.

39. (Original) The method of claim 38, wherein the MOCVD conditions include use of a lead source reagent selected from the group consisting of $Pb(thd)_2$ and $Pb(thd)_2$pmdeta.

40. (Original) The method of claim 38, wherein the MOCVD conditions include use of a zirconium source reagent selected from the group consisting of $Zr(thd)_4$ and $Zr(O\text{-}i\text{-}Pr)_2(thd)_2$.

41. (Original) The method of claim 38, wherein the MOCVD conditions include use of Ti(O-i-

$Pr)_2(thd)_2$ as a titanium source reagent.

42. (Original) The method of claim 38, wherein the MOCVD conditions include use of $Pb(thd)_2$, $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ and $Zr(thd)_4$ as respective lead, titanium and zirconium source reagents.

43. (Original) The method of claim 38, wherein the MOCVD conditions include use of $Pb(thd)_2$pmdeta, $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ and $Zr(thd)_4$ as respective lead, titanium and zirconium source reagents.

44. (Original) The method of claim 38, wherein the MOCVD conditions include use of $Pb(thd)_2$pmdeta, $Ti(O\text{-}i\text{-}Pr)_2(thd)_2$ and $Zr(O\text{-}i\text{-}Pr)_2(thd)_2$ as respective lead, titanium and zirconium source reagents.

45. (Original) The method of claim 38, wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising one or more solvent species selected from the group consisting of: tetrahydrofuran, glyme solvents, alcohols, hydrocarbon solvents, hydroaryl solvents, amines, polyamines, and mixtures of two or more of the foregoing.

46. (Original) The method of claim 38, wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising tetrahydrofuran: isopropanol: tetraglyme in an 8:2:1 volume ratio.

47. (Original) The method of claim 38, wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising octane: decane: polyamine in a 5:4:1 volume ratio.

48. (Original) The method of claim 38, wherein the source reagents are provided for liquid delivery

MOCVD in a solvent medium comprising octane: polyamine in a 9:1 volume ratio.

49. (Original) The method of claim 38, wherein the source reagents are provided for liquid delivery MOCVD in a solvent medium comprising tetrahydrofuran.

50. (Original) The method of claim 38, wherein the substrate comprises a noble metal.

51. (Original) The method of claim 38, wherein the substrate comprises a noble metal selected from the group consisting of iridium, platinum, and combinations thereof.

52. (Original) The method of claim 38, wherein the substrate comprises a TiAlN barrier layer overlaid by an iridium layer.

53. (Original) The method of claim 38, wherein the liquid delivery MOCVD includes vaporization of a source reagent solution to form precursor vapor therefrom and flowing the precursor vapor to a CVD chamber in a carrier gas.

54. (Original) The method of claim 53, wherein the carrier gas is selected from the group consisting of argon, helium and mixtures thereof.

55. (Original) The method according to claim 38, further comprising flowing to the CVD chamber an oxidant medium including at least one species selected from the group consisting of O_2, O_3, N_2O, and O_2/N_2O.

56. (Previously presented) A method of fabricating a ferroelectric PZT film on a substrate, comprising selecting MOCVD conditions including nucleation conditions producing a ferroelectric PZT

material, and forming the film by liquid delivery MOCVD on the substrate under said MOCVD conditions, wherein said selecting MOCVD conditions comprises:

establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti);

identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure and liquid precursor solution A/B ratio; and

conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation.

57. (Original) A method of fabricating a ferroelectric PZT film on a substrate, comprising forming the film by liquid delivery MOCVD on the substrate under MOCVD conditions including temperature, pressure and liquid precursor solution A/B ratio determined by plateau effect determination from a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti).

58. (Previously presented) A method of fabricating a ferroelectric PZT film on a substrate, comprising forming the film by liquid delivery MOCVD on the substrate under MOCVD conditions including temperature, pressure and liquid precursor solution A/B ratio determined by plateau effect determination from a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti), and wherein said ferroelectric PZT film comprises a ferroelectric PZT material having at least one scalable character

selected from the group consisting of dimensionally scalable character, pulse length scalable character and E-field scalable character, and wherein said PZT material has at least one property selected from the group consisting of having a thickness from about 20 to about 150 nanometers, having a ferroelectric operating voltage below 2 Volts, having at least one Type 1 properties and having at least one Type 2 properties.

59. (Cancelled).

60. (Previously presented) A method of fabricating a FeRAM device, comprising selecting MOCVD conditions producing a ferroelectric PZT material, and forming a capacitor on a substrate including a ferroelectric PZT material, wherein the ferroelectric PZT material is deposited by liquid delivery MOCVD under said MOCVD conditions yielding said ferroelectric PZT material, wherein said selecting MOCVD conditions comprises:

establishing a correlative empirical matrix of plots of each of ferroelectric polarization, leakage current density, and atomic percent lead in PZT films, as a function of each of temperature, pressure and liquid precursor solution A/B ratio, wherein A/B ratio is the ratio of Pb to (Zr + Ti);

identifying from said plots an inflection point of each plot as defining a region of operation with respect to independent process variables of temperature, pressure and liquid precursor solution A/B ratio; and

conducting the liquid delivery MOCVD at temperature, pressure and liquid precursor solution A/B ratio values selected from said region of operation.

61. (Canceled).

62. (Previously presented) The method of claim 60, wherein the PZT film defines a capacitor area of

from about 10^4 μm^2 to about 10^{-2} μm^2.

63-64. (Cancelled).

65. (Previously presented) The method of claim 38, wherein said MOCVD conditions comprise temperature in a range from about 400°C to about 1200°C, pressure in a range from about 0.1 to about 760 torr, and liquid precursor solution A/B ratio in a range of from about 0.52 to about 1.52.

66. (Previously presented) The method of claim 38, wherein said ferroelectric PZT film has a ferroelectric polarization of greater than 20 $\mu C/cm^2$.

67. (Previously presented) The method of claim 66, wherein said ferroelectric PZT film has a leakage current density of less than 10^{-4} A/cm^2.

68. (Previously presented) The method of claim 67, wherein said ferroelectric PZT film has an atomic percent lead in a range of from about 49.43% to about 55%.

69. (Cancelled).